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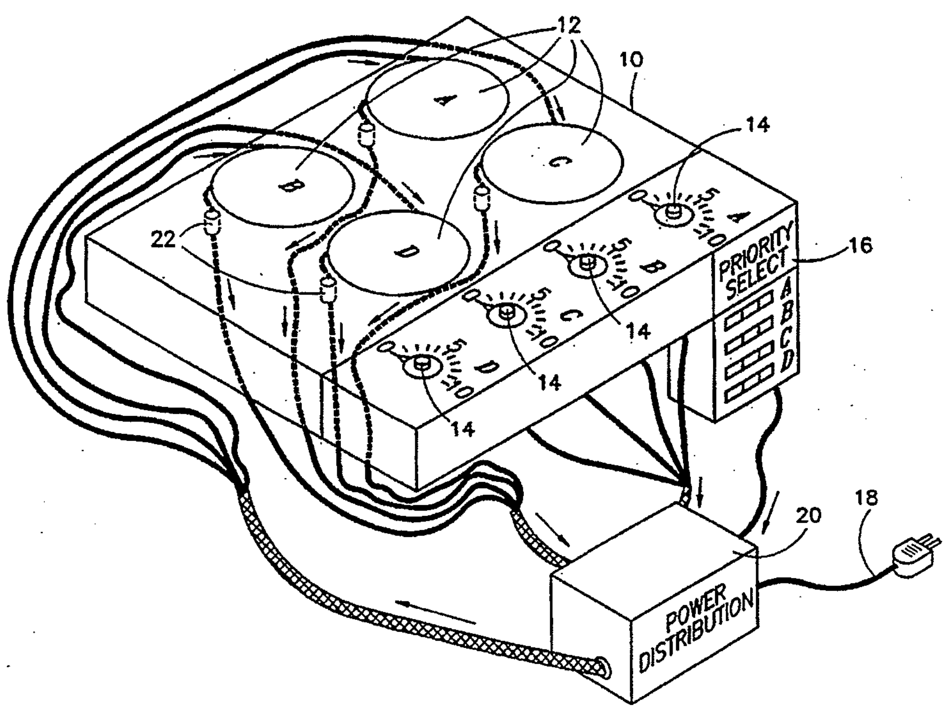

(57) Abstract

The invention discloses an electrical cooking appliance including a plurality of electrical heating elements (12) having a known maximum total wattage and an electrical power distribution apparatus (20) receiving electrical power from an electrical power source and distributing power to plural ones of the plurality of electrical heating elements (12) in accordance with an established priority when the electrical power available for distribution is less than the known maximum total wattage.

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ELECTRICAL COOKING APPARATUS

The present invention relates to electrical cooking appliances generally and more particularly to electrical stoves and stove tops and the operation thereof.

A great variety of electrical cooking appliances is known in the patent literature. Various arrangements for allocating electrical power to various heating elements in such appliances are shown in the following U.S. Patents: 3,610,886; 4,371,780; 4,482,800; 4,493,979; 4,527,049; 4,538,051; 4,634,843; 4,758,710; 4,810,857; 4,918,291; 4,948,949; 5,171,973; 5,183,996 and 5,270,519.

The present invention seeks to provide a multi-element electrical cooking appliance which is suitable for domestic applications wherein limited electrical power is available.

There is thus provided in accordance with a preferred embodiment of the present invention an electrical cooking appliance including a plurality of electrical heating elements having a known maximum total wattage and electrical power distribution apparatus receiving electrical power from an electrical power source and distributing power to plural ones of the plurality of electrical heating elements in accordance with an established prior-

ity when the electrical power available for distribution is less than the known maximum total wattage.

Preferably the distribution apparatus is responsive both to real time inputs from an operator who selects which of the electrical heating elements are to be energized and desired heating levels for each and to the established priority which indicates the allocation of available electrical power in accordance with the real time inputs from the operator.

In accordance with a preferred embodiment of the present invention, the real time inputs determine a real time total wattage which is less than or equal to the known maximum total wattage and wherein the distribution apparatus is operative for distributing power to plural ones of the plurality of electrical heating elements in accordance with the established priority when the electrical power available for distribution is less than the real time total wattage.

The established priority may be predetermined, fixed or selectable and changeable by the user.

In accordance with a preferred embodiment of the invention, when sufficient electrical power is available for heating all of the elements selected by the user to the indicated heating levels, full power is provided to such elements.

Preferably, the distribution apparatus is responsive additionally to the operative conditions of the plurality of electrical heating elements.

In accordance with a preferred embodiment of the present invention, the operative conditions of the plurality of electrical heating elements at least partially determine an operative condition responsive total wattage which is less than or equal to the known maximum total wattage and wherein the distribution apparatus is operative for distributing power to plural ones of the plurality of electrical heating elements in accordance

with the established priority when the electrical power available for distribution is less than the operative condition responsive total wattage.

Further in accordance with a preferred embodiment of the present invention, the real time inputs and the operative conditions of the plurality of electrical heating elements at least partially determine an operative condition and real time input responsive total wattage which is less than or equal to the known maximum total wattage and wherein the distribution apparatus is operative for distributing power to plural ones of the plurality of electrical heating elements in accordance with the established priority when the electrical power available for distribution is less than the operative condition and real time input responsive total wattage.

The present invention also includes a method of operating an appliance employing the inventive features summarized hereinabove.

The term "operative condition" is defined herein in a broad sense to include, for example, the temperature of the electrical heating element, the power dissipated by the electrical heating element, the power drawn by the electrical heating element, the current and/or voltage supplied thereto and the electrical resistance presented by the electrical heating element.

Reference to "temperature" is to be understood in a broader than usual sense so as to refer broadly to sensing in any suitable manner of the temperature of the electrical heating elements or other parts of the cooking appliance in the vicinity thereof. This sensing may be carried out, for example, by the use of a thermistor or other temperature sensor, or alternatively by sensing the characteristics of the electrical power drawn by the heating element, its resistance or any other physical characteristic of the heating element. The purpose of causing the power distribution to be respon-

sive to the sensed temperature may be to prevent overheating of the heating element, its environs, a cooking vessel heated thereby or the contents thereof, or for any other reason, such as to reduce energy wastage.

The present invention will be more fully understood and appreciated from the following detailed description, taken in conjunction with the drawings in which:

Fig. 1 is a simplified pictorial illustration of cooking apparatus constructed and operative in accordance with a preferred embodiment of the present invention;

Fig. 2 is a simplified block diagram illustration of electrical power distribution apparatus useful in the operation of the apparatus of Fig. 1;

Fig. 3 is a simplified power distribution diagram for the apparatus of Figs. 1 and 2;

Figs. 4A, 4B and 4C are power distribution diagrams for the apparatus of Figs. 1 and 2 for a given priority and for varying user inputs;

Figs. 5A, 5B and 5C are power distribution diagrams for the apparatus of Figs. 1 and 2 for the same priority as in Figs. 4A, 4B and 4C, taking into account operative conditions;

Figs. 6A, 6B, 6C and 6D are power distribution diagrams for the apparatus of Figs. 1 and 2 for a given partial priority and varying user inputs;

Fig. 7 is a simplified illustration of a variation of the apparatus of Fig. 1 wherein heating elements of non-identical power capacity are employed;

Fig. 8 is a simplified power distribution diagram for the apparatus of Fig. 7;

Figs. 9A, 9B and 9C are power distribution diagrams for the apparatus of Fig. 8 for a given priority and for varying user inputs;

Fig. 10 is a schematic illustration of a preferred embodiment of the circuitry of Fig. 2; and

Figs. 11A and 11B together define a schematic illustration of cooking element operating circuitry coupled to each cooking element and to the circuitry of Fig. 10.

Appendix A is a HEX dump of the software resident in the circuitry of Fig. 10.

Reference is now made to Fig. 1, which is a simplified pictorial illustration of cooking apparatus constructed and operative in accordance with a preferred embodiment of the present invention. The cooking apparatus comprises a base 10 which may be mounted on a counter or any other suitable support (not shown). Mounted on base 10 are a plurality of electrical heating elements 12, typically, but not necessarily four in number.

Electrical cooking elements 12 may be any suitable electrical resistance cooking elements, such as are found in conventional electric ranges and range tops. Alternatively they may be radiation cooking elements, such as those commercially available, inter alia from Sholtes of France. Preferably, but not necessarily, the electrical cooking elements 12 may be high efficiency cooking elements such as those described and claimed in U.S. Patent 5,221,829 of the present applicants/assignee, the disclosure of which is hereby incorporated by reference.

A plurality of control assemblies 14 are provided for enabling a user to select the amount of electrical power to be supplied to one or more of the cooking elements 12. For convenience, in Fig. 1, the four cooking elements are individually designated as cooking elements A, B, C and D. Control assemblies 14 are likewise designated by the letters A, B, C and D to indicate which control assembly 14 controls which cooking element 12.

In accordance with a preferred embodiment of the present invention, in cases when the available electric power is not sufficient, the supply of electrical power to the individual cooking elements is not determined solely by the user's operation of the control assemblies 14, but is also dependent upon a preselected

priority among the individual cooking elements 12.

This priority is established either at the factory or upon installation of the unit by employing of a priority select control panel 16. Panel 16 is normally not accessible to the user during normal use of the cooking apparatus. According to an alternative embodiment of the present invention, the priority may be selected or modified by the user after installation. In such a case, user access to panel 16 is provided.

Electrical power is supplied to the cooking apparatus from the electrical mains and preferably from a single phase electrical source via an ordinary line cord 18. Line cord 18 supplies electrical power to power distribution apparatus 20 which is responsive to the user inputs at control assemblies 14 and the priority established at panel 16 to govern the power supply to the individual cooking elements 12.

In accordance with a preferred embodiment of the present invention, but not necessarily, the power distribution apparatus 20 may also be responsive to the sensed operative conditions of the individual cooking elements 12, indicated schematically by sensing apparatus 22 associated with each cooking element 12.

Reference is now made to Fig. 2, which is a simplified block diagram illustration of the electrical power distribution apparatus 20 useful in the apparatus of Fig. 1. The apparatus of Fig. 2 includes a CPU 30 which receives user inputs from control assemblies 14, priority inputs from priority select control panel 16 and optionally receives cooking element operative conditions inputs from sensors 22. The CPU 30, whose operation will be described hereinbelow in greater detail, is operative to provide control inputs to a plurality of relays 32, designated individually A, B, C and D to correspond to the cooking elements 12. The relays 32 receive electrical power from the mains and supply it in a controlled manner

to corresponding cooking elements 12.

Reference is now made to Fig. 3 which is a simplified power distribution diagram for the apparatus of Figs. 1 and 2. The diagram of Fig. 3 indicates that for a particular, non-limiting example, each cooking element is allocated not more than 1500 Watts of electrical power at any given time. Thus, if a total of 3000 Watts of electrical power is available to the cooking apparatus of Fig. 1, only two cooking elements receive power at any given instant in time.

Power switching between cooking elements 12 occurs in cycles, each typically having four time segments, during each of which electrical power may be directed to a different cooking element by relays 32. It is appreciated that each cycle may include any desired suitable number of time segments, lesser or greater than four in number. A typical cycle has a duration of a few seconds. Normally the cycle is divided into at least ten time segments. A lesser number is shown and described herein for the sake of clarity and conciseness.

Reference is now made to Figs. 4A, 4B and 4C, which are power distribution diagrams for the apparatus of Figs. 1 and 2 for a given priority and for varying user inputs and when operative conditions sensing inputs are not employed. The example illustrated by Figs. 4A, 4B and 4C is one in which cooking element A has absolute priority over cooking element B, which in turn has absolute priority over cooking element C. Cooking element C has absolute priority over cooking element D. For the purposes of explanation and illustration it is assumed that a total of 3000 Watts of power is available to the cooking apparatus and each cooking element can receive no more than 1500 Watts at any given time.

Fig. 4A illustrates operation of the power distribution apparatus 20 in general and of CPU 30 in particular when the user inputs at the control assemblies

14 are as follows:

CONTROL I.D.	CONTROL SETTING
A	5.0
B	7.5
C	7.5
D	10.0

A setting of 10.0 corresponds to a full allotment of 1500 Watts over an entire cycle, a setting of 5.0 corresponds to a full allotment of 1500 Watts over half of an entire cycle, etc.

It is seen that notwithstanding the limited availability of electrical power and in accordance with the established priority, cooking element A receives its full requested power allotment, i.e. 1500 Watts over two of four of the time segments of each cycle. Similarly, notwithstanding the limited availability of electrical power and in accordance with the established priority, each of cooking elements B and C receives its full requested power allotment, i.e. 1500 Watts over three of four of the time segments of each cycle.

Due to the limited availability of electrical power and in accordance with the established priority, cooking element D does not receive its full requested power allotment, since no power remains available.

The power allocation illustrated in Fig. 4A continues so long as there is no change in the user input at the control assemblies 14 and no change in the established priority.

Referring now to Fig. 4B, it is seen that when there is a change in the user input at the control assemblies 14, the power distribution changes accordingly. Here it is seen that cooking element A is turned off by the user. Accordingly, the power that was previously directed to cooking element A is now available for allocation to cooking element D, which receives one-half of its full requested power allotment, i.e. 1500 Watts over

two of four of the time segments of each cycle.

Referring now to Fig. 4C, it is seen that when there is a further change in the user input at the control assemblies 14, the power distribution again changes accordingly. Here it is seen that cooking element B is also turned off by the user. Accordingly, the power that was previously directed to cooking element B is now available for redistribution and allocation to cooking element D, which receives all of its full requested power allotment, i.e. 1500 Watts over all four of the time segments of each cycle. In this case, some of the available electrical power is not used.

It is noted that at no time is more than 3000 Watts of electrical power drawn from the mains and that all allocations of power are carried out by time division of the supply of power in quantities of 1500 Watts.

Reference is now made to Figs. 5A, 5B and 5C, which are power distribution diagrams for the apparatus of Figs. 1 and 2 for a given priority and for varying user inputs and when operative conditions sensing inputs are employed. The priority is exactly the same as in the example illustrated in Figs. 4A, 4B and 4C, i.e. cooking element A has absolute priority over cooking element B, which in turn has absolute priority over cooking element C. Cooking element C has absolute priority over cooking element D.

As in the example shown in Figs. 4A - 4C, for the purposes of explanation and illustration it is assumed that a total of 3000 Watts of power is available to the cooking apparatus and each cooking element can receive no more than 1500 Watts at any given time.

Fig. 5A illustrates operation of the power distribution apparatus 20 in general and of CPU 30 in particular when the user inputs at the control assemblies 14 are as follows:

CONTROL I.D.	CONTROL SETTING
A	10.0
B	7.5
C	7.5
D	10.0

It is seen that notwithstanding the limited availability of electrical power and in accordance with the established priority, cooking element A receives its full requested power allotment, i.e. 1500 Watts over all four of the time segments of each cycle. Similarly, notwithstanding the limited availability of electrical power and in accordance with the established priority, cooking element B receives its full requested power allotment, i.e. 1500 Watts over three of four of the time segments of each cycle.

Due to the limited availability of electrical power and in accordance with the established priority, cooking element C receives only part of its full requested power allotment, i.e. 1500 Watts over one of four of the time segments of each cycle, since no additional power remains available.

Cooking element D does not receive its full requested power allotment, since no power remains available.

The power allocation illustrated in Fig. 5A continues so long as there is no change in the user input at the control assemblies 14, no change in the established priority and no effective change in the cooking element operative conditions inputs.

Referring now to Fig. 5B, it is seen that when there is an effective change in the operative conditions input to CPU 30, the power distribution changes accordingly. The term "effective change" is used here to denote the exceedance of a predetermined threshold which causes the CPU 30 to cut down or cut off the power supply to the

corresponding cooking element.

Here it is seen that when the operative conditions of the cooking element A exceed a predetermined threshold resulting in a predetermined cut down of electrical power thereto, the power that was previously directed to cooking element A is now available for redistribution to cooking element C and D. Cooking element C now receives all of its full required power allotment, i.e. 1500 Watts over three of four of the time segments of each cycle and cooking element D now receives one-quarter of its full requested power allotment, i.e. 1500 Watts over one of four of the time segments of each cycle.

Referring now to Fig. 5C, it is seen that when there is a further change in the effective operative conditions input to the CPU 30, the power distribution again changes accordingly. Here it is seen if the operative conditions of cooking element A change sufficiently so that full electric power supply thereto is recommenced, the power that was previously redistributed to cooking elements C and D is now made available once again to cooking element A, in a time distribution which typically is identical to that shown in Fig. 5A, in accordance with the predetermined priority.

Reference is now made to Figs. 6A, 6B, 6C and 6D, which are power distribution diagrams for the apparatus of Figs. 1 and 2 for a different priority from that illustrated in Figs. 4A - 5C and for varying user inputs and when operative conditions sensing inputs are not employed.

The example illustrated by Figs. 6A, 6B, 6C and 6D is one in which cooking element A has priority over cooking element B, which in turn has priority over cooking element C. Cooking element C has priority over cooking element D. The priorities are not, however, absolute, as in the case illustrated in Figs. 4A - 5C. Rather,

notwithstanding the priority, each of the cooking elements is guaranteed availability of a portion of its full power allotment in accordance with the following table:

COOKING ELEMENT	% GUARANTEED
A	75%
B	75%
C	25%
D	25%

For the purposes of explanation and illustration it is assumed that a total of 3000 Watts of power is available to the cooking apparatus and each cooking element can receive no more than 1500 Watts at any given time.

Fig. 6A illustrates operation of the power distribution apparatus 20 in general and of CPU 30 in particular when the user inputs at the control assemblies 14 are as follows:

CONTROL I.D.	CONTROL SETTING
A	10.0
B	10.0
C	0.0
D	0.0

A setting of 10.0 corresponds to a full allotment of 1500 Watts over an entire cycle.

It is seen that notwithstanding the established priority, since sufficient power is available to meeting the user inputs, each of cooking elements A and B receives its full requested power allotment, i.e. 1500 Watts over all four of the time segments of each cycle. The power allotment guaranteed to cooking elements C and D but not requested, is thus utilized by cooking elements A and B.

The power allocation illustrated in Fig. 6A

continues so long as there is no change in the user input at the control assemblies 14 and no change in the established priority.

Referring now to Fig. 6B, it is seen that when there is a change in the user input at the control assemblies 14, the power distribution changes accordingly. Here it is seen that cooking element C is turned on by the user to a setting 10.0. Accordingly, some of the power that was previously directed to cooking element B is allocated to cooking element C, which receives its guaranteed power allocation, in this case one-quarter of its full requested power allotment, i.e. 1500 Watts over one of four of the time segments of each cycle. Cooking element B gives up power rather than cooking element A in accordance with the established priority.

Referring now to Fig. 6C, it is seen that when there is a further change in the user input at the control assemblies 14, the power distribution again changes accordingly. Here it is seen that cooking element D is also turned on by the user to a setting 10.0. Accordingly, some of the power that was previously directed to cooking element A is allocated to cooking element D, which receives its guaranteed power allocation, in this case one-quarter of its full requested power allotment, i.e. 1500 Watts over one of four of the time segments of each cycle. It is seen that in this situation, each cooking element receives its guaranteed allocation.

Referring now to Fig. 6D, it is seen that when there is yet a further change in the user input at the control assemblies 14, the power distribution once again changes accordingly. Here it is seen that cooking element A is turned off by the user. Accordingly, the power that was previously directed to cooking element A is allocated to other cooking elements in accordance with the established priority. Thus cooking element B receives its full requested allocation, i.e. 1500 Watts over all four

of the time segments of each cycle and cooking element C receives most of its requested allocation, i.e. 1500 Watts over three of the four time segments of each cycle. It is seen that in this situation, each cooking element receives at least its guaranteed allocation to the extent requested.

Reference is now made to Fig. 7, which is a simplified pictorial illustration of part of cooking apparatus constructed and operative in accordance with another preferred embodiment of the present invention. The cooking apparatus may be identical to that illustrated in Fig. 1 and described hereinabove, with the sole exception that here, cooking element A has twice the output capacity of each of the remaining cooking elements B, C and D. Thus, if each of cooking elements B, C and D is arranged to receive up to 1000 Watts at any given time, cooking element A is arranged to receive up to 2000 Watts at any given time.

Reference is now made to Fig. 8 which is a simplified power distribution diagram for the apparatus of Fig. 7. The diagram of Fig. 8 indicates that for a particular, non-limiting example, each of cooking elements B, C and D is allocated not more than 1000 Watts of electrical power at any given time and cooking element A is allocated not more than 2000 Watts of electrical power at any given time. Thus if only 3000 Watts of electrical power is available at any given time, all of the cooking elements cannot be operated at full capacity at the same time.

Reference is now made to Figs. 9A, 9B and 9C, which are power distribution diagrams for the apparatus of Fig. 7 for a given priority and for varying user inputs and when operative conditions sensing inputs are not employed. The example illustrated by Figs. 9A, 9B and 9C is one in which cooking element A has absolute priority over cooking element B, which in turn has absolute

priority over cooking element C. Cooking element C has absolute priority over cooking element D.

Fig. 9A illustrates operation of the power distribution apparatus 20 in general and of CPU 30 in particular when the user inputs at the control assemblies 14 are as follows:

CONTROL I.D.	CONTROL SETTING
A	20.0
B	10.0
C	10.0
D	10.0

A setting of 20.0 for cooking element A corresponds to a full allotment of 2000 Watts over an entire cycle, and a setting of 10.0 for cooking elements B, C and D corresponds to a full allotment of 1000 Watts over an entire cycle.

It is seen that notwithstanding the limited availability of electrical power and in accordance with the established priority, cooking element A receives its full requested power allotment, i.e. 2000 Watts over all four of the time segments of each cycle. Similarly, notwithstanding the limited availability of electrical power and in accordance with the established priority, cooking element B receives its full requested power allotment, i.e. 1000 Watts over all four of the time segments of each cycle.

Due to the limited availability of electrical power and in accordance with the established priority, cooking elements C and D do not receive their full requested power allotment, since no power remains available.

The power allocation illustrated in Fig. 9A continues so long as there is no change in the user input at the control assemblies 14 and no change in the established priority.

Referring now to Fig. 9B, it is seen that when there is a change in the user input at the control assemblies 14, the power distribution changes accordingly. Here it is seen that the power requested by the user at cooking element B is reduced. Accordingly, the power that was previously directed to cooking element B is now available for allocation to cooking element C, which receives one-half of its full requested power allotment, i.e. 1000 Watts over two of four of the time segments of each cycle.

Referring now to Fig. 9C, it is seen that when there is a further change in the user input at the control assemblies 14, the power distribution again changes accordingly. Here it is seen that the power requested by the user at cooking element A is also reduced. Accordingly, the power that was previously directed to cooking element A is now available for redistribution and allocation to cooking element C, which now receives its full requested power allotment, i.e. 1000 Watts over all four time segments of each cycle, and to cooking element D which receives one half of its full requested power allotment, i.e. 1000 Watts over two of the four time segments of each cycle.

It is noted that at no time is more than 3000 Watts of electrical power drawn from the mains and that all allocations of power are carried out by time division of the supply of power.

Reference is now made to Fig. 10 which is a self-explanatory schematic illustration of a preferred embodiment of the circuitry of Fig. 2. The circuitry of Fig. 10 includes a microprocessor 90, preferably a Motorola MC 68705R5. A HEX dump in Motorola S Record Format of a preferred embodiment of the operating software resident in the microprocessor 90 is incorporated herein in Appendix A. The circuitry of Fig. 10 and the software employed therein includes the provision of an optional

timer function which enables automatic turning off of a cooking element after a preset time.

Reference is now made to Figs. 11A and 11B, which together define a self-explanatory schematic illustration of a preferred embodiment of cooking element operating circuitry which is coupled to each cooking element and to the circuitry of Fig. 10, as indicated thereon.

It is to be appreciated that systems combining features from the various embodiments illustrated and described herein are also within the scope of the invention.

It will be appreciated that the present invention is not limited by what has been particularly shown and described hereinabove. Rather the scope of the present invention is defined only by the claims which follow:

Appendix A

S00600004844521B
S1230100B742A44A2704A609B700B642A1402604A640B700B642A1412604A64FB700B6421B
S1230120A1422604A624B700B642A1432604A630B700B642A1442604A619B700B642A1453F
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S1050FFE05E701
S1041FDF00FD
S9030000FC

CLAIMS

1. An electrical cooking appliance including a plurality of electrical heating elements having a known maximum total wattage and electrical power distribution apparatus receiving electrical power from an electrical power source and distributing power to plural ones of the plurality of electrical heating elements in accordance with an established priority when the electrical power available for distribution is less than the known maximum total wattage.

2. An appliance according to claim 1 and wherein the distribution apparatus is responsive both to real time inputs from an operator who selects which of said electrical heating elements are to be energized and desired heating levels for each and to the established priority which indicates the allocation of available electrical power in accordance with the real time inputs from the operator.

3. An appliance according to claim 2 and wherein said real time inputs determine a real time total wattage which is less than or equal to said known maximum total wattage and wherein said distribution apparatus is operative for distributing power to plural ones of the plurality of electrical heating elements in accordance with said established priority when the electrical power available for distribution is less than said real time total wattage.

4. An appliance according to any of claims 1 - 3 and wherein said established priority is predetermined.

5. An appliance according to any of claims 1 - 3 and wherein said established priority is fixed.

6. An appliance according to any of claims 1 - 3 and wherein said established priority is selectable and changeable by the user.

7. An appliance according to any of the preceding claims and being operative such that when sufficient electrical power is available for heating all of the elements selected by the user to the indicated heating levels, full power is provided to such elements.

8. An appliance according to any of the preceding claims and wherein said distribution apparatus is responsive additionally to the operative conditions of the plurality of electrical heating elements.

9. An appliance according to claim 8 and wherein the operative conditions of the plurality of electrical heating elements at least partially determine an operative condition responsive total wattage which is less than or equal to said known maximum total wattage and wherein said distribution apparatus is operative for distributing power to plural ones of the plurality of electrical heating elements in accordance with said established priority when the electrical power available for distribution is less than said operative condition responsive total wattage.

10. An appliance according to claim 2 and claim 8 and wherein the real time inputs and the operative conditions of the plurality of electrical heating elements at least partially determine an operative condition and real time input responsive total wattage which is less than or equal to said known maximum total wattage and wherein said distribution apparatus is operative for distributing power to plural ones of the plurality of electrical

heating elements in accordance with said established priority when the electrical power available for distribution is less than said operative condition and real time input responsive total wattage.

11. A method of operating an electrical cooking appliance including a plurality of electrical heating elements having a known maximum total wattage comprising the steps of:

defining an established priority for supply of electrical power to individual ones of said plurality of electrical heating elements; and

distributing electrical power from an electrical power source to plural ones of the plurality of electrical heating elements in accordance with said established priority when the electrical power available for distribution is less than the known maximum total wattage.

12. A method according to claim 11 and wherein said distributing step is responsive both to real time inputs from an operator who selects which of said electrical heating elements are to be energized and desired heating levels for each and to the established priority which indicates the allocation of available electrical power in accordance with the real time inputs from the operator.

13. A method according to claim 12 and wherein said real time inputs determine a real time total wattage which is less than or equal to said known maximum total wattage and wherein said distributing step includes distributing power to plural ones of the plurality of electrical heating elements in accordance with said established priority when the electrical power available for distribution is less than said real time total wattage.

14. A method according to any of claims 11 - 13 and wherein said established priority is predetermined.

15. A method according to any of claims 11 - 13 and wherein said established priority is fixed.

16. A method according to any of claims 11 - 13 and wherein said established priority is selectable and changeable by the user.

17. A method according to any of the preceding claims 11 - 16 and wherein when sufficient electrical power is available for heating all of the elements selected by the user to the indicated heating levels, full power is provided to such elements.

18. A method according to any of the preceding claims 11 - 17 and wherein said distributing step is responsive additionally to the operative conditions of the plurality of electrical heating elements.

19. A method according to claim 18 and wherein the operative conditions of the plurality of electrical heating elements at least partially determine an operative condition responsive total wattage which is less than or equal to said known maximum total wattage and wherein said distributing step is operative for distributing power to plural ones of the plurality of electrical heating elements in accordance with said established priority when the electrical power available for distribution is less than said operative condition responsive total wattage.

20. A method according to claim 12 and claim 18 and wherein the real time inputs and the operative conditions

of the plurality of electrical heating elements at least partially determine an operative condition and real time input responsive total wattage which is less than or equal to said known maximum total wattage and wherein said distributing step is operative for distributing power to plural ones of the plurality of electrical heating elements in accordance with said established priority when the electrical power available for distribution is less than said operative condition and real time input responsive total wattage.

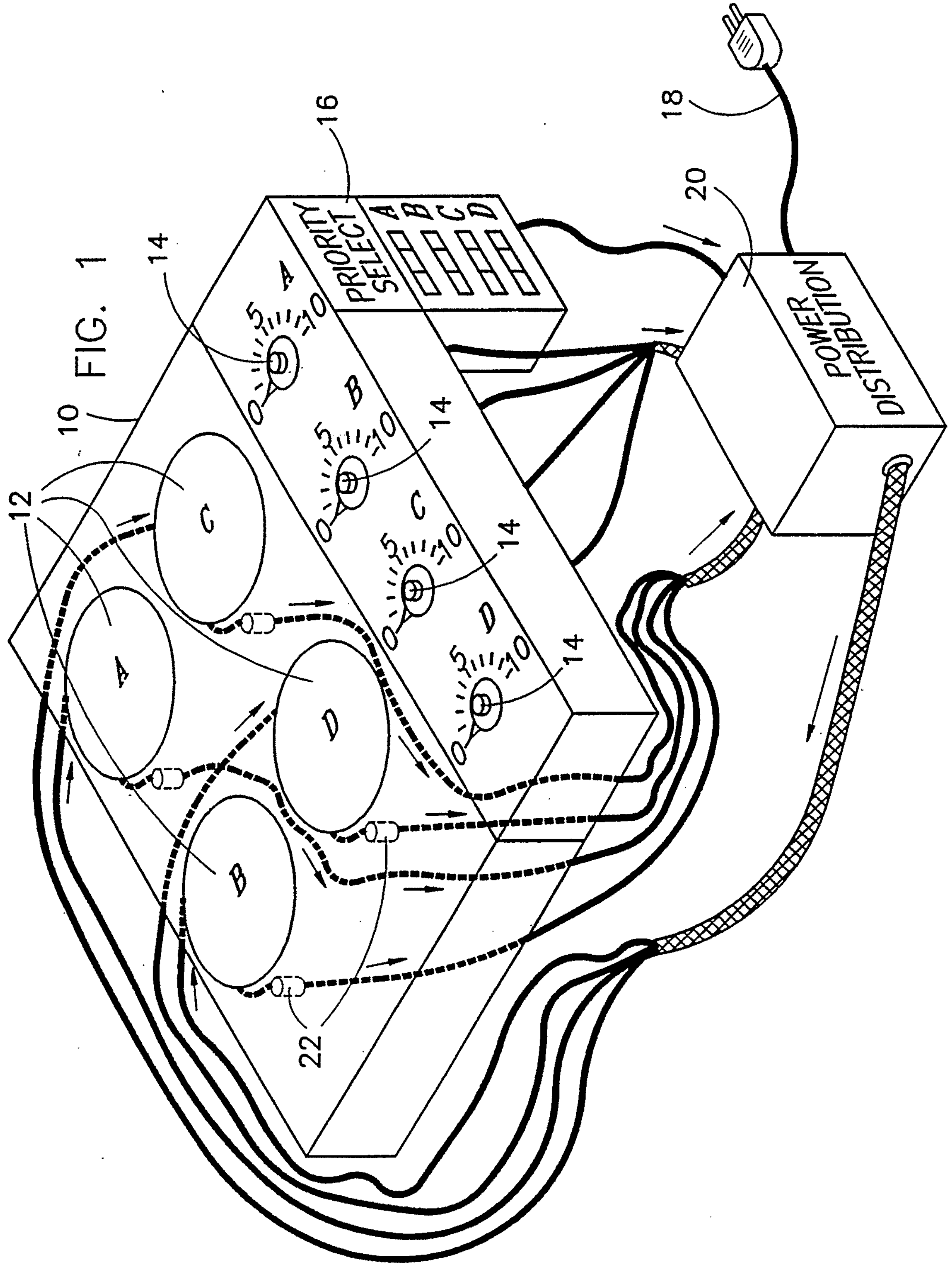

PRIORITY SELECT
A
B
C
D
POWER DISTRIBUTION
10
12
14
16
18
20
22
5
10

FIG. 1

FIG. 2

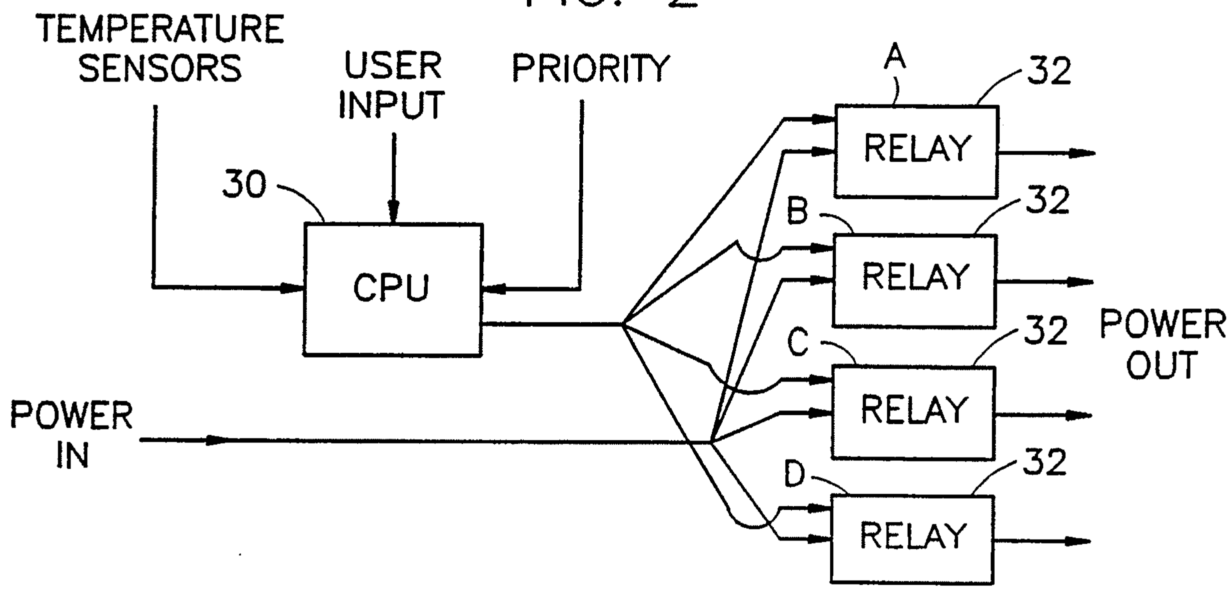
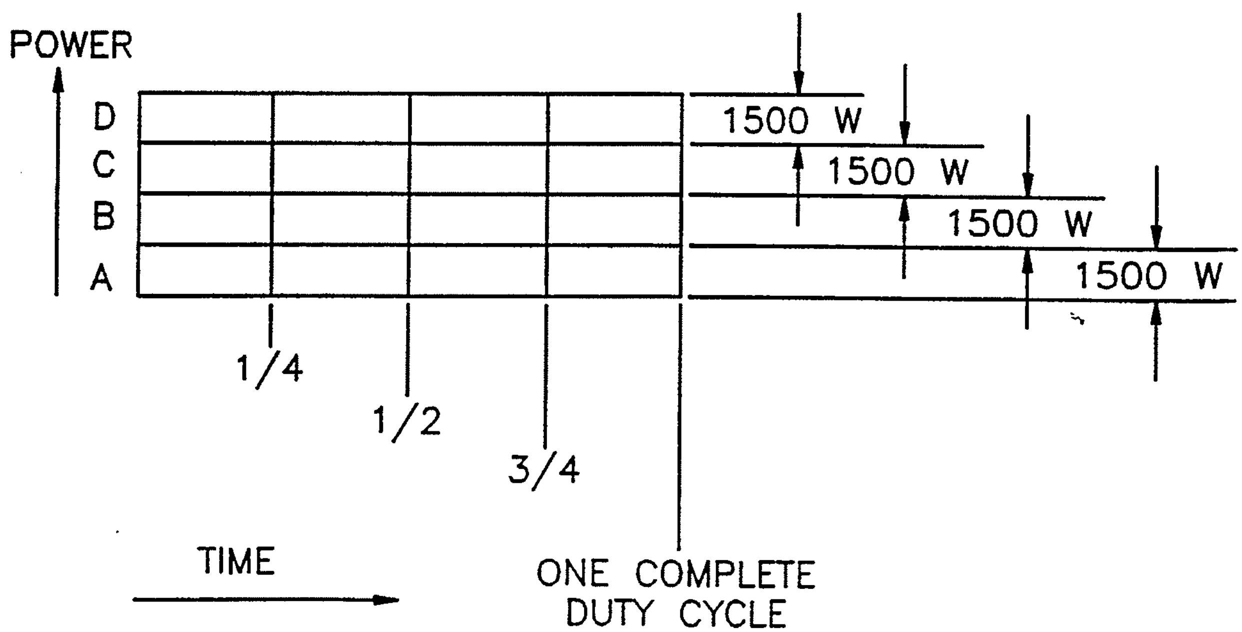

TEMPERATURE SENSORS
USER INPUT
PRIORITY
30
CPU
POWER IN
A
B
C
D
32
RELAY
POWER OUT

FIG. 3


POWER
D
C
B
A
1500 W
1500 W
1500 W
1500 W
1/4
1/2
3/4
TIME
ONE COMPLETE DUTY CYCLE

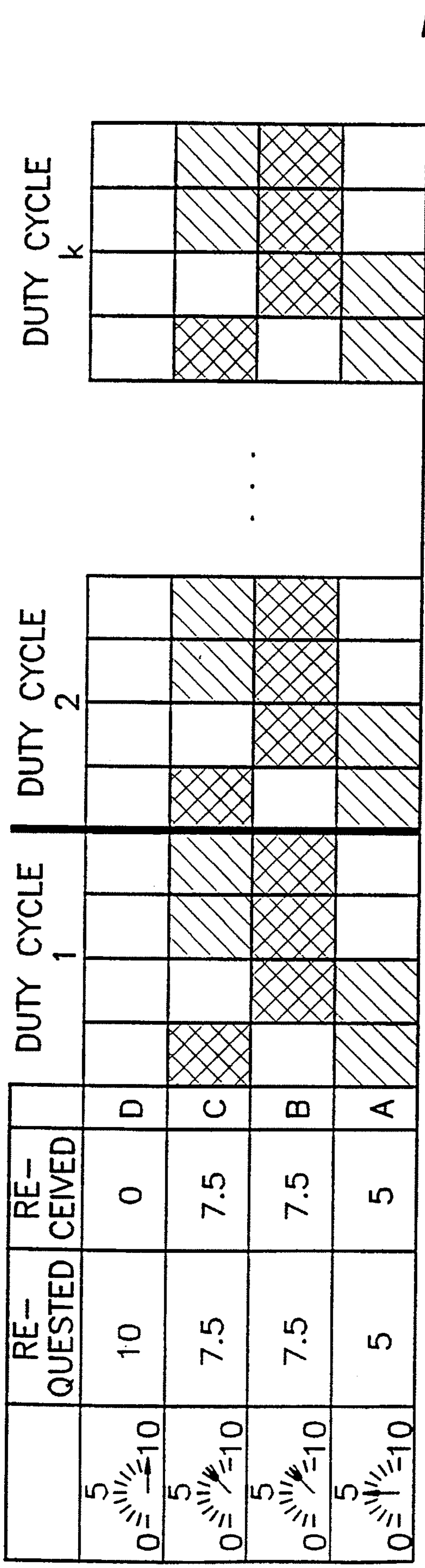


FIG. 4A

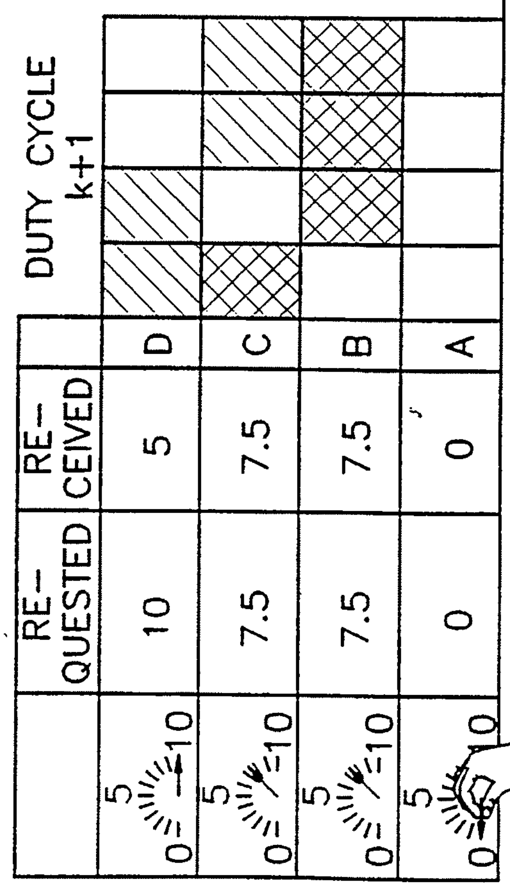


FIG. 4B

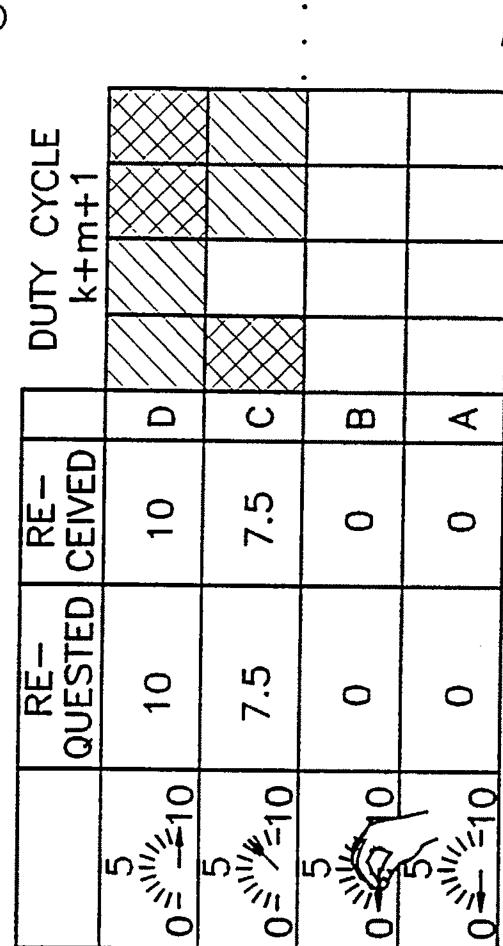


FIG. 4C

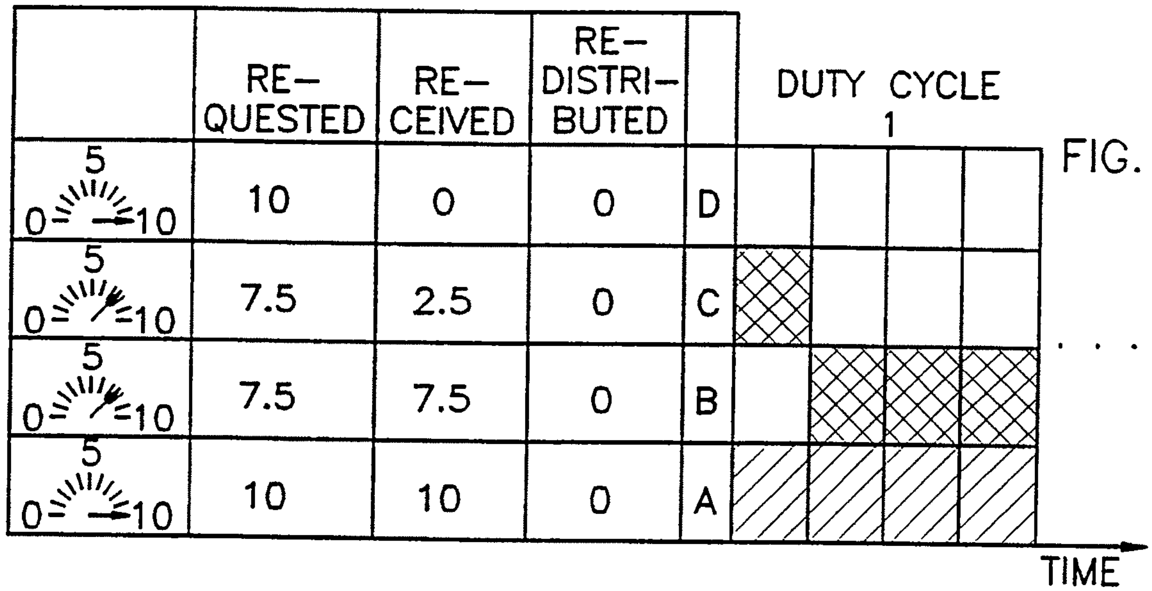


FIG. 5A

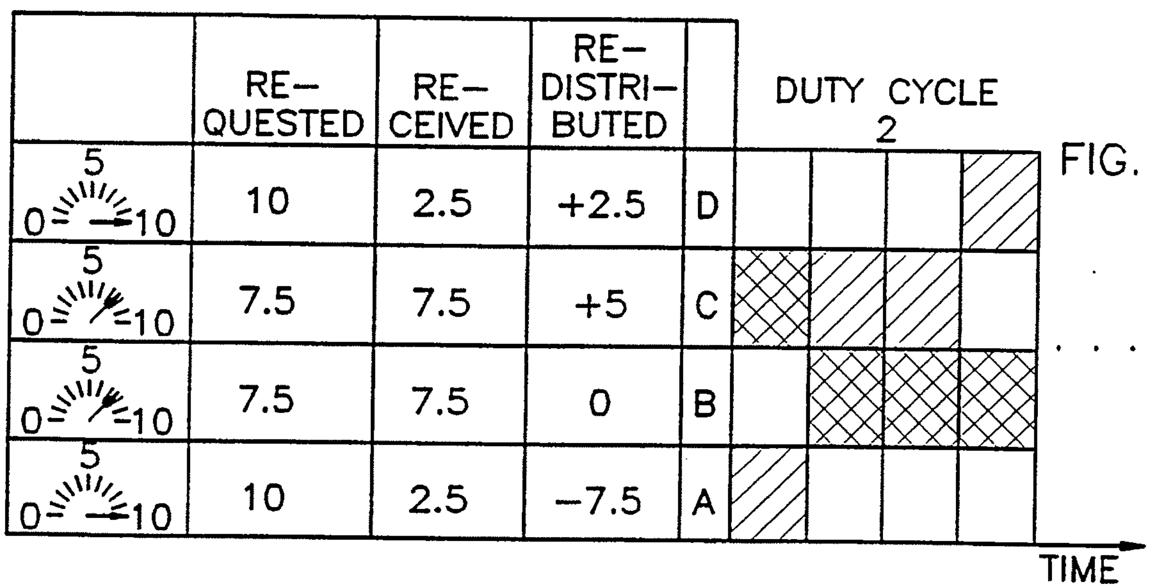


FIG. 5B

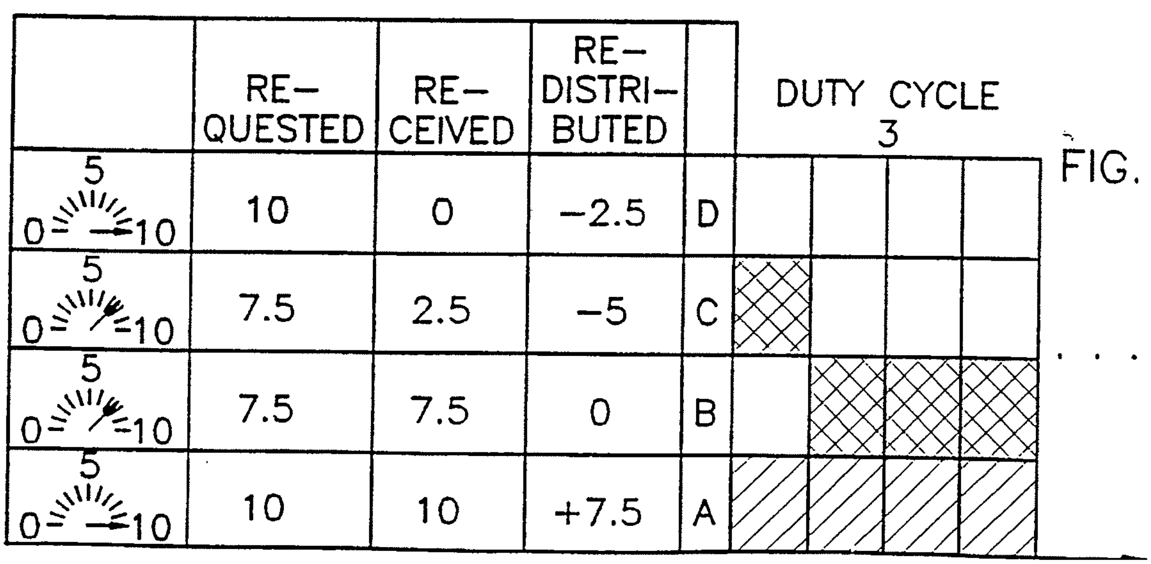


FIG. 5C

FIG. 6A

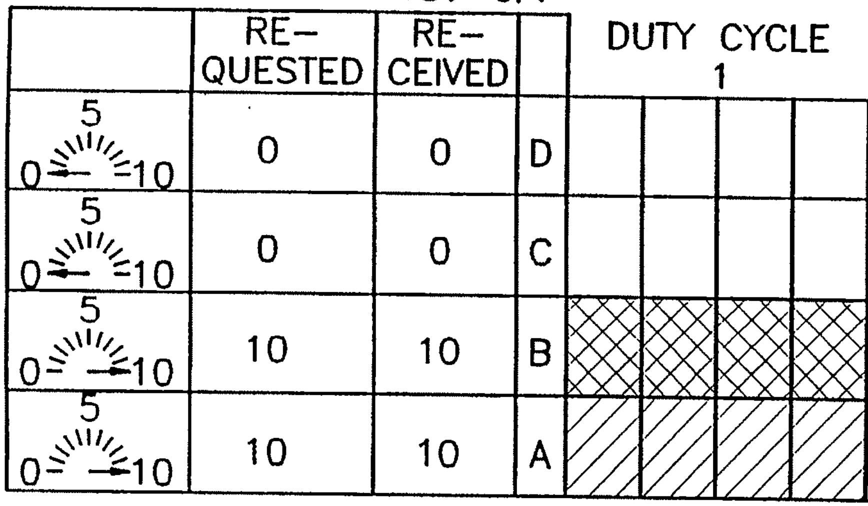


FIG. 6B

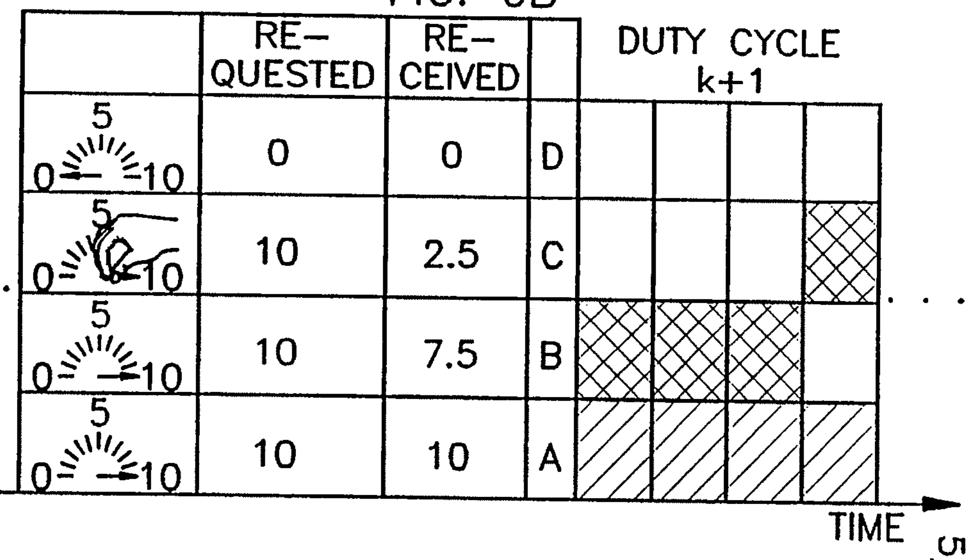


FIG. 6C

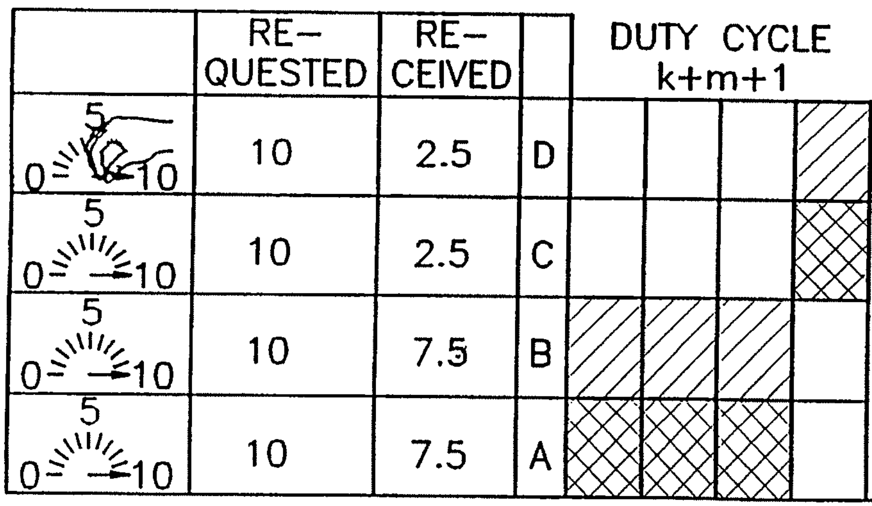
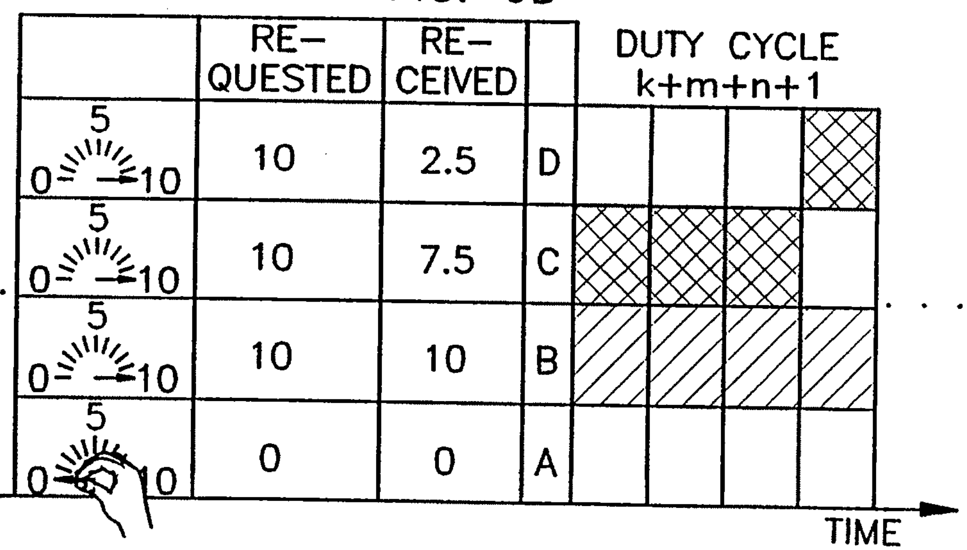


FIG. 6D



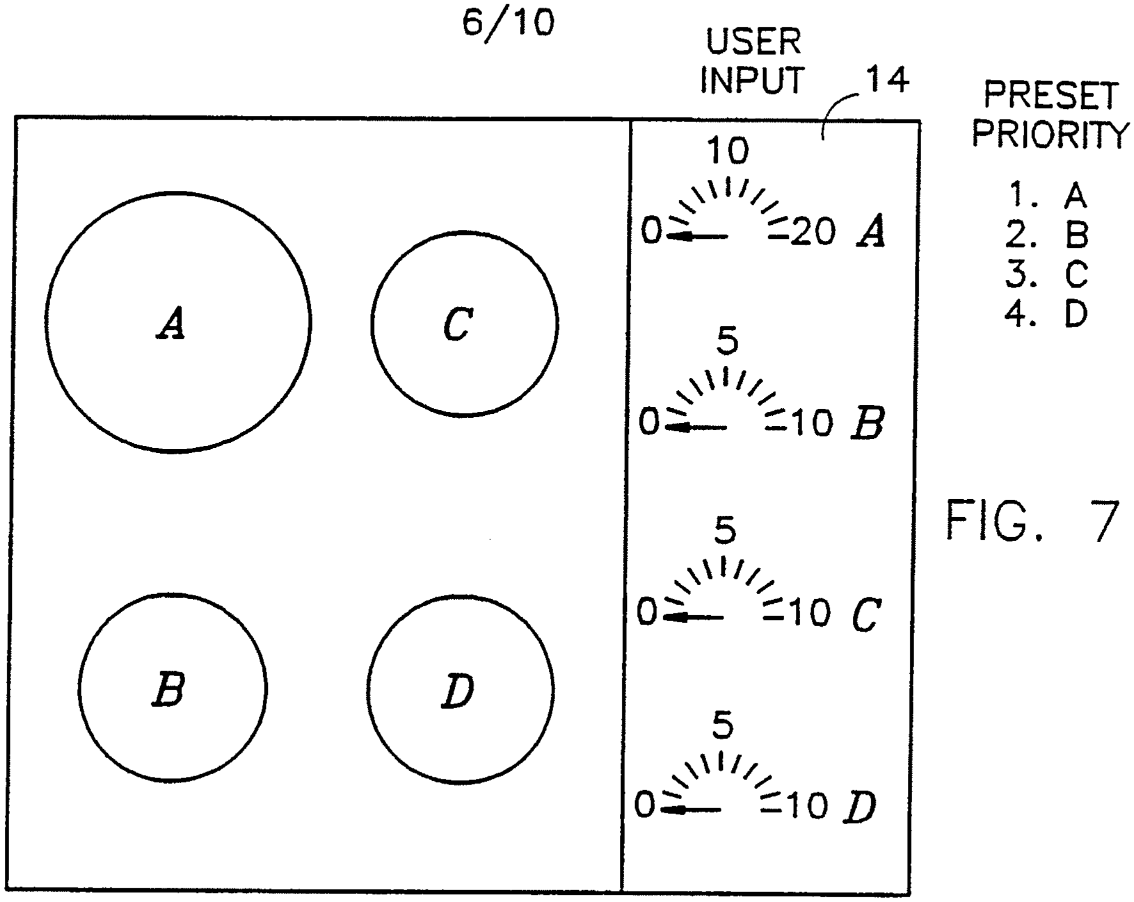
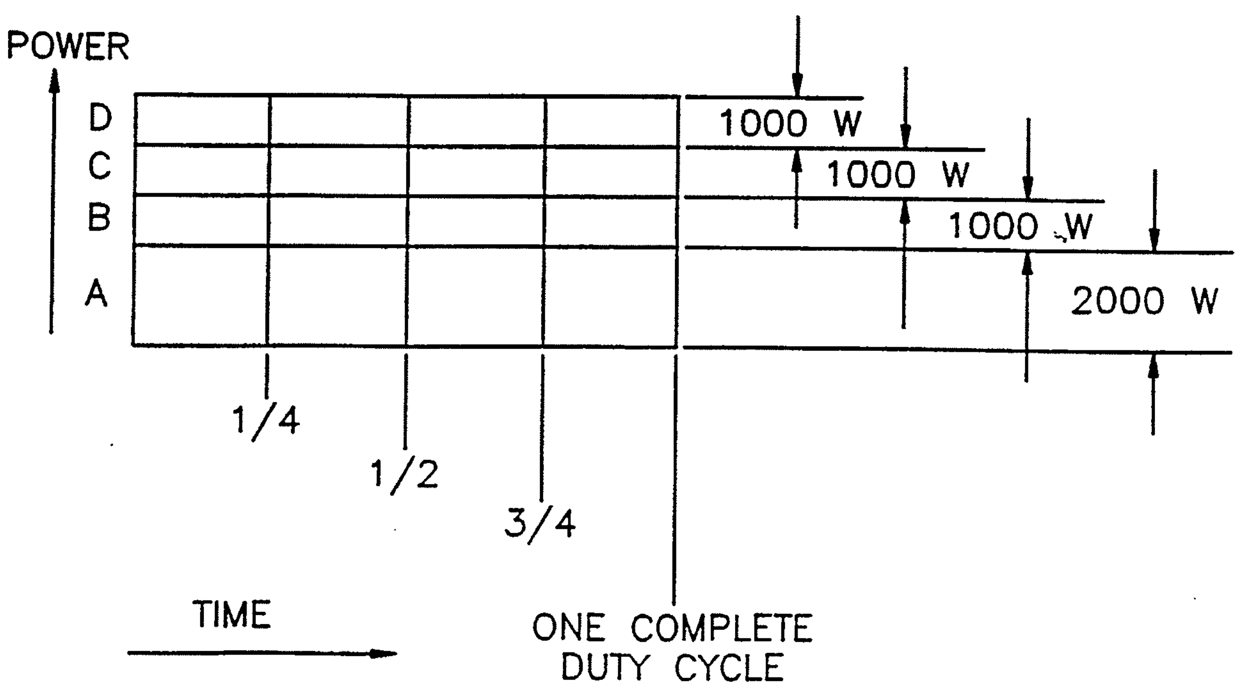

USER INPUT
14
10
0
20
A
C
B
D
5
0
10
B
5
0
10
C
5
0
10
D
PRESET PRIORITY
1. A
2. B
3. C
4. D

FIG. 7

FIG. 8


POWER
D
C
B
A
1000 W
1000 W
1000 W
2000 W
1/4
1/2
3/4
TIME
ONE COMPLETE DUTY CYCLE

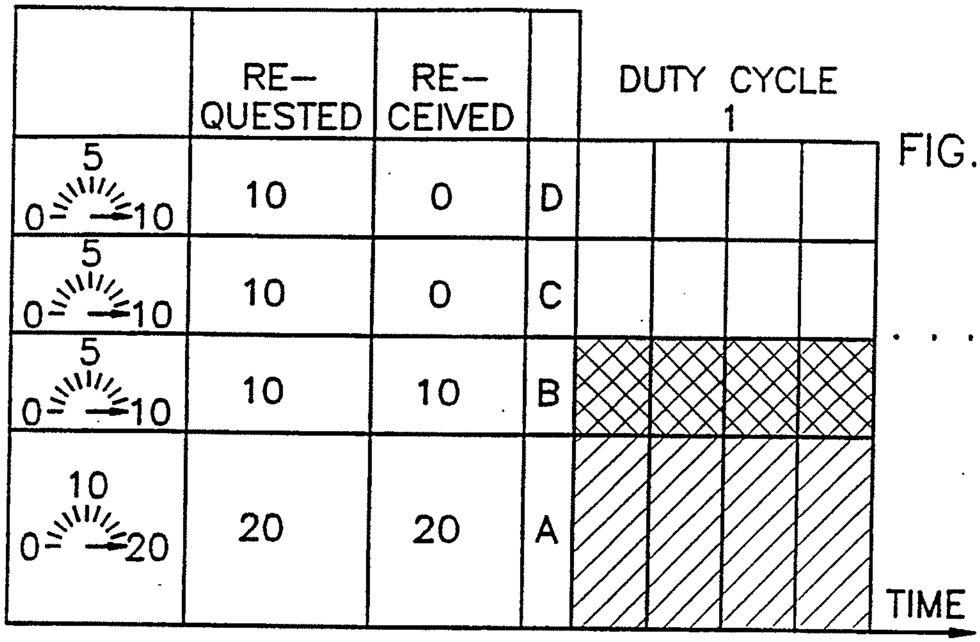


FIG. 9A

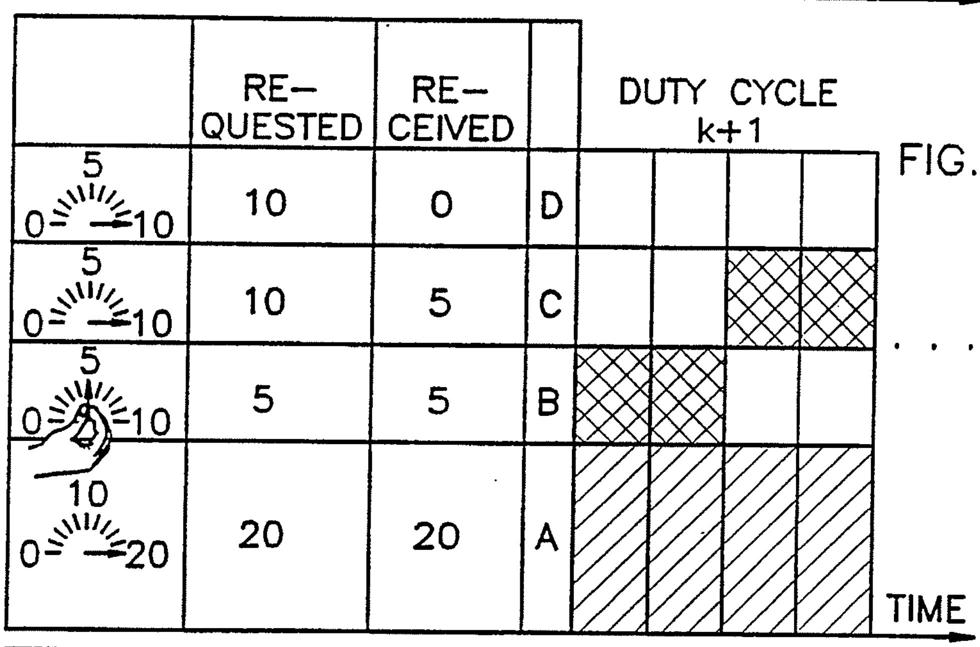


FIG. 9B

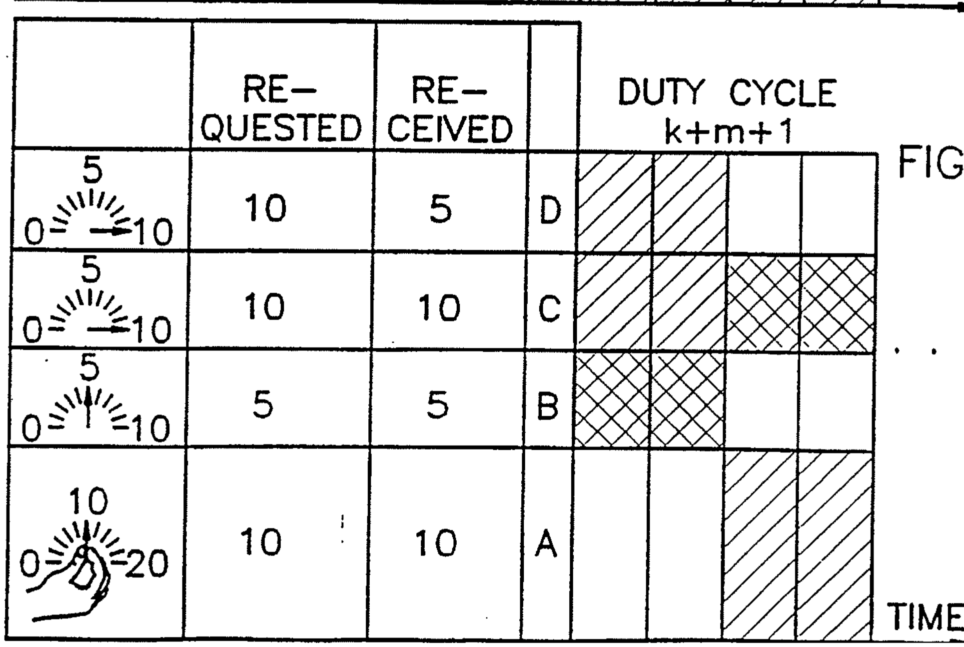
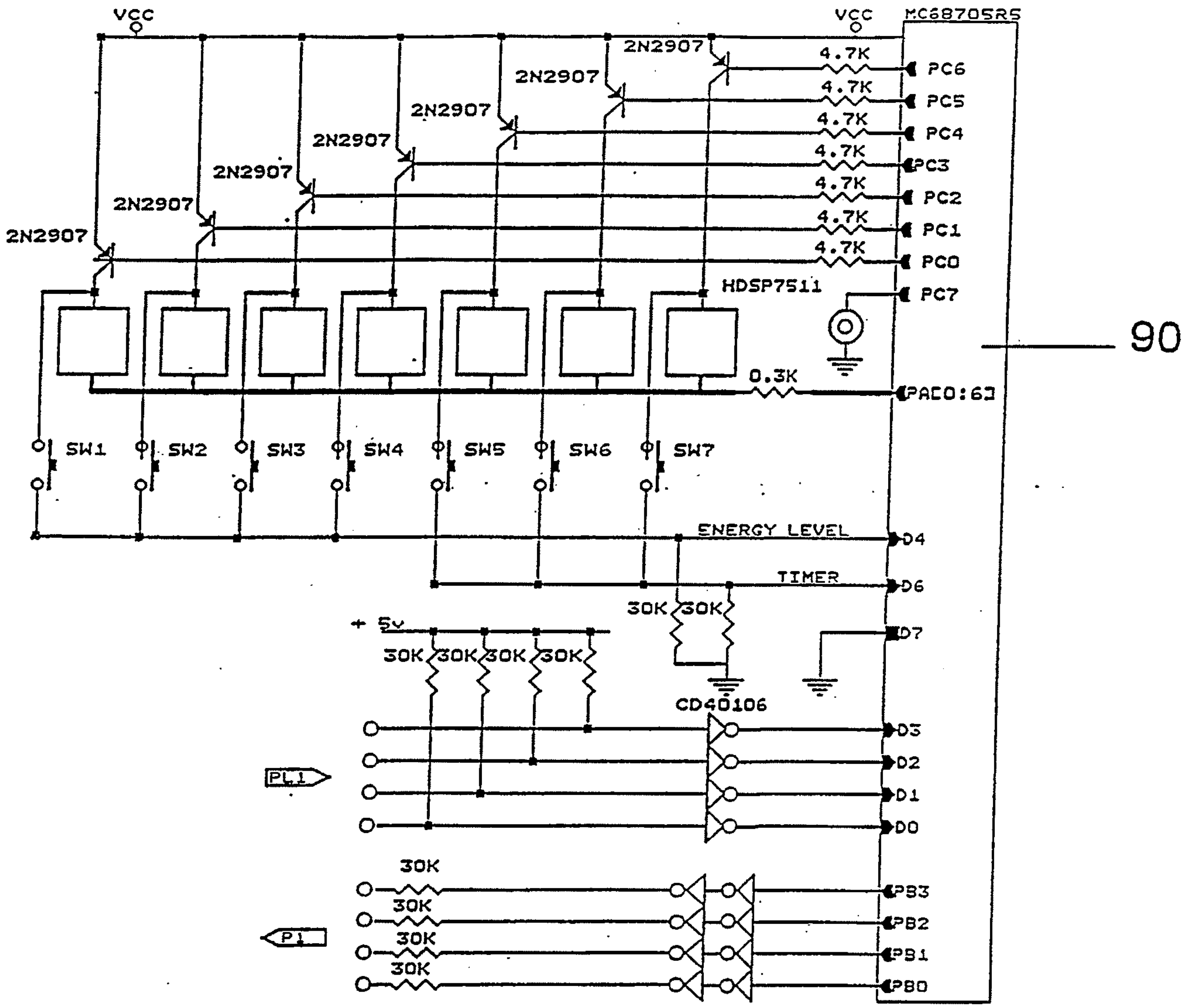


FIG. 9C


VCC
VCC
MC68705R5
2N2907
2N2907
2N2907
2N2907
2N2907
2N2907
2N2907
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4.7K
4.7K
4.7K
4.7K
4.7K
4.7K
PC6
PC5
PC4
PC3
PC2
PC1
PC0
PC7
HDSP7511
0.3K
PA[0:6]
SW1
SW2
SW3
SW4
SW5
SW6
SW7
ENERGY LEVEL
D4
TIMER
D6
D7
30K
30K
+ 5v
30K
30K
30K
30K
CD40106
D3
D2
D1
D0
PL1
30K
30K
30K
30K
P1
PB3
PB2
PB1
PB0

FIG. 10

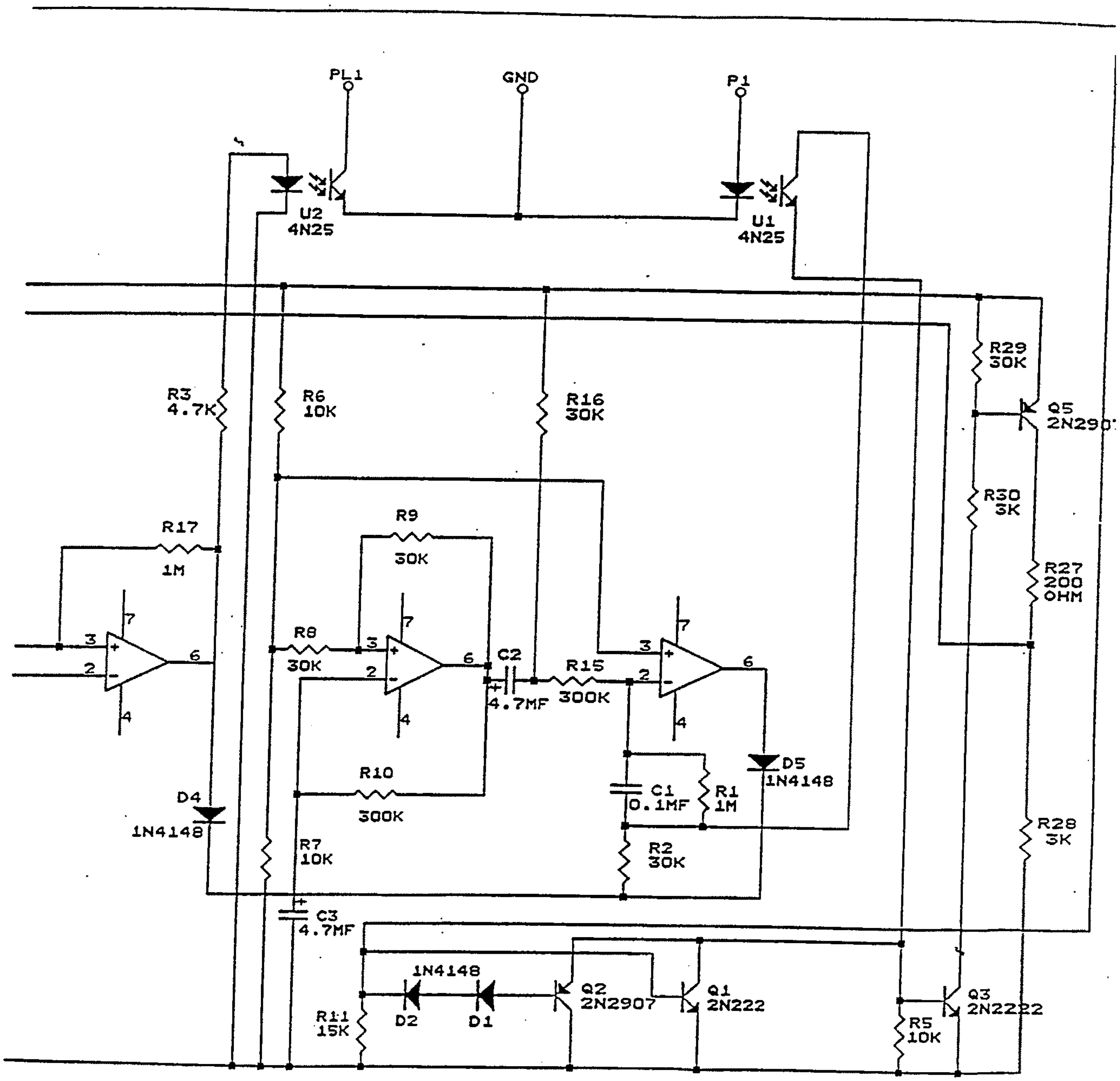
PL1
GND
P1
U2
4N25
U1
4N25
R29
30K
Q5
2N2907
R3
4.7K
R6
10K
R16
30K
R30
3K
R17
1M
R9
30K
R27
200
OHM
R8
30K
C2
4.7MF
R15
300K
R10
300K
C1
0.1MF
R1
1M
D5
1N4148
D4
1N4148
R7
10K
R2
30K
R28
3K
C3
4.7MF
1N4148
D2
D1
Q2
2N2907
Q1
2N222
Q3
2N2222
R11
15K
R5
10K

FIG. 11A

10/10

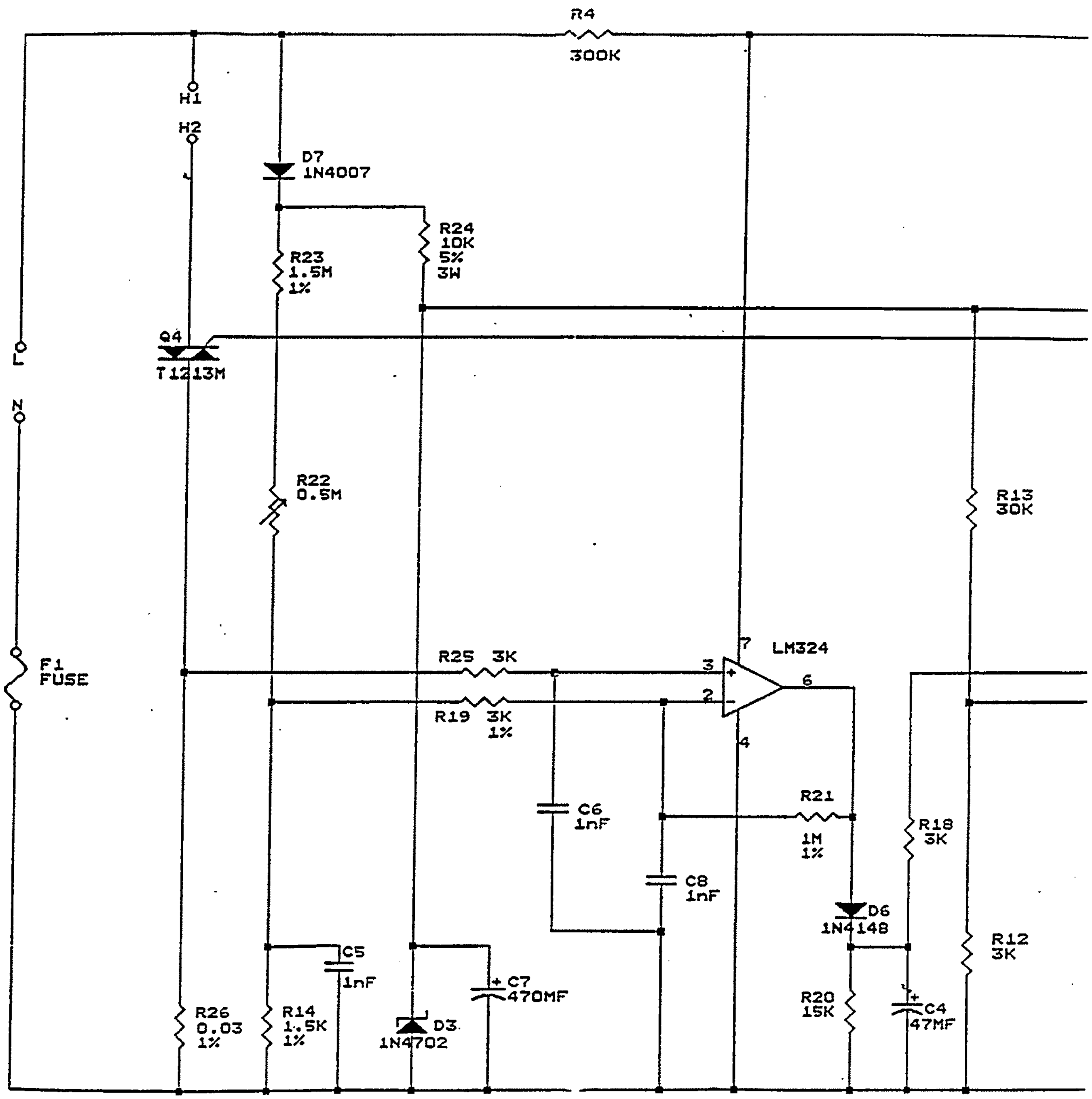
R4
300K
H1
H2
D7
1N4007
R24
10K
5%
3W
R23
1.5M
1%
Q4
T1213M
L
N
R22
0.5M
R13
30K
F1
FUSE
R25 3K
7
LM324
3
2
6
4
R19 3K
1%
R21
1M
1%
C6
1nF
C8
1nF
R18
3K
D6
1N4148
C5
1nF
C7
470MF
R12
3K
R26
0.03
1%
R14
1.5K
1%
D3
1N4702
R20
15K
C4
47MF

FIG. 11B

International application No.
PCT/US95/04748

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :HO5B 1/02 ; HO2J 3/00
US CL :219/464,485,486,497,506 ;307/39
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 219/464,485,486,497,506 ,501,481 ;307/39,38,40,41

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

Aps Text Search

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US, A, 4,160,153, (MELANDER), 03 JULY 1979,(SEE ENTIRE DOCUMENT)	1-6,11-16
A	US, A, 4,138,607, (ENGELMANN), 06 FEB 1979, (SEE ENTIRE DOCUMENT)	1-6,11-16
A	US, A, 4,066,913, (MANNING ET AL), 03 JAN 1978, (SEE COL. 2 LINES 7-20)	1-6,11-16
Y,E	US, A, 5,422,517, (VERNEY ET AL) , 06 JUNE 1995, (SEE COL. 2, LINES 63 -69)	1-6,11-16
Y	US , 4,419,666, (GURR ET AL), 06 DEC 1983, SEE COL. 13 LINES 43-68)	1-6,11-16

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
28 AUGUST 1995	05 SEP 1995

Name and mailing address of the ISA/US	Authorized officer
Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231	MARK PASCHALL
Facsimile No. (703) 305-3230	Telephone No. (703) 308-1642

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☒ Claims Nos.: 7-10,17-20
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.